

## PATENT CLAIMS

### 1. Packaging machine equipped

- with sensors, actuators and drive systems, comprising a servo motor,
- a central control unit
- and a system for data transmission,
- the actual values of the sensors, actuators and drive systems
  - being recorded in digital form in each case
  - and transferred with the use of a transmission protocol via the data transmission system to the central control unit,
  - evaluated by the latter
- and the determined setpoint values or control commands
  - being also transmitted in digital form
  - and with the use of the transmission protocol from the control system via the data transmission system to the actuators or drives,

#### **characterised in that**

- the data transmission between sensors (2), actuators (3), drives (4) and central control unit (7) and vice versa takes place wirelessly,
- the transmission protocol
  - operating cyclically with short cycle times, preferably in millisecond pulse,
  - performing a synchronisation of all sensors (2), actuators (2), drives (4) with time-dependent actions,
  - and providing the actual values and the determined setpoint values of all drives (4) in each cycle, the accuracy of the synchronisation and the provision lying in the microsecond range.
- essential information is redundant
- and errors in the data transmission can be eliminated by means of error correction processes, for example the HDLC process.

2. Packaging machine according to claim 1, characterised in that
  - the control of the drives (4) takes place by specifying position or velocity data and the associated points in times,
  - the control unit (7) or a controller (4'') assigned to each of the drives (4) has, in each case, an interpolator assigned to it
    - which generates the time function of the position and velocity data by means of interpolation between the aforementioned determined setpoint values of the drives.
3. Packaging machine according to claim 1 or 2, characterised in that
  - the wireless data transmission (6) can be realised by radio, preferably broadband radio, or infrared communication.
4. Packaging machine according to one of claims 1-3, characterised in that
  - the data transmission between the central control unit (7) and the respective sensors (2), actuators (3) or drives (4) and in the opposite direction takes place in each case unidirectionally or bidirectionally.
5. Packaging machine according to one of claims 1-4, characterised in that
  - the central control unit (7) is built up from PC hardware.
6. Packaging machine according to one of claims 1-5, characterised in that
  - a programming unit (8) is connected to the central control unit (7).

7. Packaging machine according to one of claims 1-6, characterised in that
- the adaptation of the sensors (2) and/or actuators (3) and/or drives (4) to the packaging function is performed by means of parameters
    - which are stored in the control unit (7) or in the sensors (2) or actuators (3), or drives (4) respectively.
8. Packaging machine according to claim 7, characterised in that
- the parameters can be set or modified by means of the transmission protocol.
9. Packaging machine according to one of claims 1-8, characterised in that
- the sensors (2) and/or actuators (3) and/or drives (4) generate information and transmit it to the control unit (7),
    - which can be used for diagnosis purposes,
  - the control unit (7)
    - evaluating the aforesaid information
    - and, in the event of disturbances in the operation, generating suitable control measures according to programmed settings.
10. Packaging machine according to one of the preceding claims, characterised in that the process data of slowly running processes are only recorded in individual time-spaced cycle pulses, so that only the data of the fast processes are contained in the cycle pulses lying in between.

11. Packaging material according to one of the preceding claims, characterised in that assigned to each cycle pulse is a time window, which, despite the transmission of the aforementioned data, comprises an (unused) residual time, which can be used for transmitting optional information.
12. Packaging machine according to claims 9-11, characterised in that
  - on shutdown in the event of a fault, on operation interrupts, power failure, switching off or emergency stop, the control measures effect a synchronous braking and, on start-up of the packaging machine, effect a synchronous acceleration of the drives.
13. Packaging machine according to one of claims 1-12, characterised in that
  - the fault diagnosis takes place locally or as remote diagnosis via modem.